Fracture Pressure and Fracture Gradient

Calculated fracture gradient and maximum injection pressure values are given in Table 1. There is no site-specific data for the fracture pressure or fracture gradient in the injection and confining zones yet. However, Shryock (Shryock, 1968) has indicated that the fracture gradient can vary from 0.6 to 1.0 psi/ft due to the structural stresses and formation elasticity. Fracture gradient is closely related to formation breakdown. Limiting injection pressure below fracture gradient will prevent the initiation/propagation of vertical and horizontal fracture. (DOGGR, Evaluation and Surveillance of Water Injection Projects), contains average breakdown gradient data for oil fields located in Central and Southern California. The listed breakdown gradients were compiled by (Shryock, 1968) from the squeeze-cementing operations at various depth. The breakdown gradient is 0.63-0.64psi/ft at 5000 to 8000 feet depth in San Joaquin Valley basin. This number is somewhat lower than the state's Class II UIC program document which indicated a historical fracture gradient of 0.7psi/ft for the Coalinga District (Walker, 2011). A higher fracture gradient of 0. 96 psi/ft in San Joaquin basin was observed from a step rate test (Mathis, 2000). To be conservative in terms of fracture pressure, 0.65 psi/ft was assumed for the fracture gradient in the model and 90% of the fracture pressure was used as a constraint for the reservoir simulation.

Table 1: Injection pressure details.

Injection Pressure Details	Injection Well 1
Fracture gradient (psi/ft)	0.65
Maximum injection pressure (90% of fracture pressure) (psi)	5677.4
Elevation corresponding to maximum injection pressure (ft MSL)	-9505
Elevation at the top of the perforated interval (ft MSL)	-9400
Calculated maximum injection pressure at the top of the perforated interval (psi)	5616

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